

### *The Claims*

The listing of claims will replace all prior versions, and listings of claims in the application.

Claims 1-62. (canceled)

63. (previously presented) A composition comprising:

(a) a core particle with at least one first attachment site, wherein said core particle comprises a virus-like particle of an RNA-bacteriophage;

(b) at least one antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is ghrelin or a ghrelin peptide; and wherein said second attachment site is selected from the group consisting of:

(i) an attachment site not naturally occurring with said antigen or antigenic determinant; and

(ii) an attachment site naturally occurring with said antigen or antigenic determinant,

and wherein said first attachment site is a lysine residue of said virus-like particle and said second attachment site is a cysteine residue, wherein said second attachment site associates with said first attachment site through at least one non-peptide covalent bond; and wherein said ghrelin or ghrelin peptide and said core

particle interact through said association to form an ordered and repetitive antigen array, and wherein said composition induces an immune response against ghrelin when administered to a mammal.

Claims 64-67 (canceled)

68. (previously presented) The composition of claim 63, wherein said virus-like particle comprises recombinant proteins, or fragments thereof, of an RNA-bacteriophage.

69. (previously presented) The composition of claim 63, wherein said RNA-bacteriophage is selected from the group consisting of:

- (a) bacteriophage Q $\beta$ ;
- (b) bacteriophage R17;
- (c) bacteriophage fr;
- (d) bacteriophage GA;
- (e) bacteriophage SP;
- (f) bacteriophage MS2;
- (g) bacteriophage M11;
- (h) bacteriophage MX1;
- (i) bacteriophage NL95;
- (k) bacteriophage f2;
- (l) bacteriophage PP7; and

(m) bacteriophage AP205.

70. (previously presented) The composition of claim 63; wherein said virus-like particle of an RNA-bacteriophage comprises recombinant proteins, or fragments thereof, of RNA-bacteriophage Q $\beta$ .

71. (previously presented) The composition of claim 63, wherein said virus-like particle of an RNA-bacteriophage comprises recombinant proteins, or fragments thereof, of RNA-bacteriophage AP205.

72. (previously presented) The composition of claim 68, wherein said recombinant proteins comprise coat proteins of RNA bacteriophages, wherein said coat proteins of RNA bacteriophages have an amino acid sequence selected from the group consisting of:

- (a) SEQ ID NO:4;
- (b) SEQ ID NO:6;
- (c) SEQ ID NO:7;
- (d) SEQ ID NO:8;
- (e) SEQ ID NO:9;
- (f) SEQ ID NO:11;
- (g) SEQ ID NO:12;
- (h) SEQ ID NO:13;
- (i) SEQ ID NO:14;

- (j) SEQ ID NO:15;
- (k) SEQ ID NO:16; and
- (l) SEQ ID NO:28;

73. (previously presented) The composition of claim 63, wherein said core particle is a virus-like particle of RNA-bacteriophage Q $\beta$  comprising a mixture of (a) recombinant proteins having an amino acid sequence of SEQ ID NO:4 and (b) recombinant proteins having an amino acid sequence of SEQ ID NO:5.

74. (withdrawn) The composition of claim 63, wherein said core particle is a virus-like particle of RNA-bacteriophage SP comprising a mixture of (a) recombinant proteins having an amino acid sequence of SEQ ID NO:9 and (b) recombinant proteins having an amino acid sequence of SEQ ID NO:10.

75. (previously presented) The composition of claim 68, wherein said recombinant proteins comprise mutant coat proteins of RNA-bacteriophage.

76. (previously presented) The composition of claim 75, wherein said mutant coat proteins of said RNA bacteriophage have been modified by (i) removal of at least one lysine residue by way of substitution, (ii) addition of at least one lysine residue by way of substitution; (iii) deletion of at least one lysine residue; or (iv) addition of at least one lysine residue by way of insertion.

77. (canceled)

78. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin, a ghrelin peptide or a ghrelin fragment, of a species of animal selected from the group consisting of:

- (a) a human;
- (b) a bovine;
- (c) a sheep;
- (d) a dog;
- (e) a cat;
- (f) a mouse;
- (g) a pig; and
- (h) a horse.

79. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide of a species of animal selected from the group consisting of:

- (a) a human;
- (b) a bovine;
- (c) a sheep;
- (d) a dog;
- (e) a cat;

- (f) a mouse;
- (g) a pig; and
- (h) a horse.

80. (previously presented) The composition of claim 63, wherein said ghrelin or said ghrelin peptide comprises an amino acid sequence selected from the group consisting of:

- (a) GSSFLSPEHQRVQRKESKKPPAKLQPR (SEQ ID NO: 48);
- (b) GSSFLSPEHQRVQQRKESKKPPAKLQPR (SEQ ID NO: 31);
- (c) GSSFLSPEHQKLQQRKESKKPPAKLQPR (SEQ ID NO: 49);
- (d) GSSFLSPEHQKLQRKESKKPPAKLQPR (SEQ ID NO: 50);
- (e) GSSFLSPEHQKAQQRKESKKPPAKLQPR (SEQ ID NO: 32);
- (f) GSSFLSPEHQKAQRKESKKPPAKLQPR (SEQ ID NO: 51);
- (g) KKPPAKLQPR (SEQ ID NO: 52);
- (h) PPAKLQPR (SEQ ID NO: 53);
- (i) AKLQPR (SEQ ID NO: 54);
- (j) GSSFLSPEHQ (SEQ ID NO: 55);
- (k) EHQRVQQRKE (SEQ ID NO: 56);
- (l) KLQPR (SEQ ID NO: 59);
- (m) GSSFLSPEHQRVQ (SEQ ID NO: 60);
- (n) QRKESKKPPAKLQPR (SEQ ID NO: 61);
- (o) GSSFLSPEHQKLQ (SEQ ID NO: 62);
- (p) QRKESKKPPAKLQPR (SEQ ID NO: 63);

- (q) EHQRVQQRKES (SEQ ID NO: 111);
- (r) EHQKAQQRKE (SEQ ID NO: 112);
- (s) EHQKAQQRKES (SEQ ID NO: 113);
- (t) EHQKLQQRKE (SEQ ID NO: 114);
- (u) EHQKLQQRKES (SEQ ID NO: 115);
- (v) LSPEHQRVQQ (SEQ ID NO: 116);
- (w) LSPEHQKAQQ (SEQ ID NO: 117);
- (x) LSPEHQKLQQ (SEQ ID NO: 118); and
- (y) GSSFLSP (SEQ ID NO: 119).

81. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant further comprises an amino acid linker with said second attachment site.

82. (previously presented) The composition of claim 81, wherein said antigen or said antigenic determinant is ghrelin, and wherein said amino acid linker with said second attachment site is bound to the C-terminus of said ghrelin.

83. (previously presented) The composition of claim 81, wherein said amino acid linker with said second attachment site is selected from the group consisting of:

- (a) GGC;
- (b) GGC-CONH<sub>2</sub>;

- (c) GC;
- (d) GC-CONH<sub>2</sub>;
- (e) C; and
- (f) C-CONH<sub>2</sub>.

84. (previously presented) The composition of claim 63, wherein said ghrelin or said ghrelin peptide with said at least one second attachment site comprises an amino acid sequence selected from the group consisting of:

- (a) CGSSFLSPEHQRVQRKESKKPPAKLQPR (SEQ ID NO: 64);
- (b) CGSSFLSPEHQRVQQRKESKKPPAKLQPR (SEQ ID NO: 65);
- (c) CGSSFLSPEHQKLQQRKESKKPPAKLQPR (SEQ ID NO: 71);
- (d) CGSSFLSPEHQKLQRKESKKPPAKLQPR (SEQ ID NO: 72);
- (e) CGSSFLSPEHQKAQQRKESKKPPAKLQPR (SEQ ID NO: 77);
- (f) CGSSFLSPEHQKAQRKESKKPPAKLQPR (SEQ ID NO: 106);
- (g) GSSFLSPEHQRVQRKESKKPPAKLQPRC (SEQ ID NO: 66);
- (h) GSSFLSPEHQRVQRKESKKPPAKLQPRGC (SEQ ID NO: 120);
- (i) GSSFLSPEHQRVQQRKESKKPPAKLQPRC (SEQ ID NO: 67);
- (j) GSSFLSPEHQRVQQRKESKKPPAKLQPRGC (SEQ ID NO: 121);
- (k) GSSFLSPEHQKLQQRKESKKPPAKLQPRC (SEQ ID NO: 73);
- (l) GSSFLSPEHQKLQQRKESKKPPAKLQPRGC (SEQ ID NO: 123);
- (m) GSSFLSPEHQKLQRKESKKPPAKLQPRC (SEQ ID NO: 74);



- (n) GSSFLSPEHQKLQRKESKKPPAKLQPRGC (SEQ ID NO: 124);
- (o) GSSFLSPEHQKAQQRKESKKPPAKLQPRC (SEQ ID NO: 105);
- (p) GSSFLSPEHQKAQRKESKKPPAKLQPRC (SEQ ID NO: 107);
- (q) CKKPPAKLQPR (SEQ ID NO: 108);
- (r) CPPAKLQPR (SEQ ID NO: 70);
- (s) CAKLQPR (SEQ ID NO: 109);
- (t) GSSFLSPEHQC (SEQ ID NO: 110);
- (u) CEHQRVQQRKE (SEQ ID NO: 76);
- (v) GSSFLSPEHQRVQC (SEQ ID NO: 68);
- (w) GSSFLSPEHQRVQGC (SEQ ID NO: 122);
- (x) CQRKESKKPPAKLQPR (SEQ ID NO: 69);
- (y) GSSFLSPEHQKLQC (SEQ ID NO: 75);
- (z) GSSFLSPEHQKLQGC (SEQ ID NO: 125);
- (aa) GSSFLSPEHQKAQRKESKKPPAKLQPRC (SEQ ID NO: 126);
- (bb) GSSFLSPEHQKAQRKESKKPPAKLQPRGC (SEQ ID NO: 127);
- (cc) GSSFLSPEHQKAQQRKESKKPPAKLQPRC (SEQ ID NO: 128);
- (dd) GSSFLSPEHQKAQQRKESKKPPAKLQPRGC (SEQ ID NO: 129);
- (ee) GSSFLSPEHQKAQC (SEQ ID NO: 130);
- (ff) GSSFLSPEHQKAQGC (SEQ ID NO: 131);
- (gg) GGSSFLSPEHQGC (SEQ ID NO: 132);
- (hh) CKKPPAKLQPR (SEQ ID NO: 133);
- (ii) CEHQKAQQRKE (SEQ ID NO: 134);

- (jj) CEHQKAQQRKES (SEQ ID NO: 135);
- (kk) CLSPEHQKAQQ (SEQ ID NO: 136);
- (ll) CEHQRVQQRKES (SEQ ID NO: 137); and
- (mm) CLSPEHQRVQQ (SEQ ID NO: 138).

85. (previously presented) The composition of claim 63, wherein said ghrelin or ghrelin peptide lacks an n-octanoyl modification.

86. (previously presented) The composition of claim 63, wherein said first attachment site comprises an amino group.

87. (previously presented) The composition of claim 63, wherein said second attachment site comprises a sulfhydryl group.

88. (previously presented) The composition of claim 63, wherein said first attachment site comprises an amino group and wherein said second attachment site comprises a sulfhydryl group.

Claims 89-93. (canceled)

94. (previously presented) The composition of claim 63, wherein said ghrelin or ghrelin peptide consists of an amino acid sequence selected from the group consisting of:

- (a) GSSFLSPEHQRVQRKESKKPPAKLQPR (SEQ ID NO: 48);
- (b) GSSFLSPEHQRVQQRKESKKPPAKLQPR(SEQ ID NO: 31);
- (c) GSSFLSPEHQKLQQRKESKKPPAKLQPR(SEQ ID NO: 49);
- (d) GSSFLSPEHQKLQRKESKKPPAKLQPR(SEQ ID NO: 50);
- (e) GSSFLSPEHQKAQQRKESKKPPAKLQPR(SEQ ID NO: 32);
- (f) GSSFLSPEHQKAQRKESKKPPAKLQPR(SEQ ID NO: 51);
- (g) GSSFLSPEHQ(SEQ ID NO: 55);
- (h) GSSFLSPEHQRVQ (SEQ ID NO: 60);
- (i) GSSFLSPEHQKLQ (SEQ ID NO: 62); and
- (j) GSSFLSP (SEQ ID NO: 119).

95. (canceled)

96. (canceled)

97. (previously presented) The composition of claim 63, wherein said RNA-bacteriophage is RNA-bacteriophage Q $\beta$ .

98. (previously presented) The composition of claim 97, wherein said virus-like particle of RNA-bacteriophage Q $\beta$  comprises one or more recombinant proteins having the amino acid sequence set forth in SEQ ID NO:4.

99. (withdrawn) The composition of claim 97, wherein said virus-like particle of RNA-bacteriophage Q $\beta$  comprises recombinant mutant coat proteins having the amino acid sequence selected from the group consisting of:

- (a) SEQ ID NO:17;
- (b) SEQ ID NO:18;
- (c) SEQ ID NO:19;
- (d) SEQ ID NO:20; and
- (e) SEQ ID NO:21.

100. (previously presented) The composition of claim 63, wherein said virus-like particle of an RNA-bacteriophage comprises one or more recombinant proteins having the amino acid sequence set forth in SEQ ID NO:4.

101. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin of a species of animal selected from the group consisting of:

- (a) a human;
- (b) a bovine;
- (c) a sheep;
- (d) a dog;
- (e) a cat;
- (f) a mouse;
- (g) a pig; and

(h) a horse.

102. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is ghrelin consisting of a polypeptide having the amino acid sequence set forth in SEQ ID NO:31.

103. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide comprising a peptide having the amino acid sequence set forth in SEQ ID NO:119.

104. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:119.

105. (withdrawn) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:55.

106. (withdrawn) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:60.

107. (withdrawn) The composition of claim 63, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:62.

108. (previously presented) The composition of claim 63, wherein said antigen or antigenic determinant contains an n-octanoyl modification of a serine residue being or corresponding to the serine residue at position 3 of SEQ ID NO:31.

109. (previously presented) The composition of claim 100, wherein said antigen or antigenic determinant is a ghrelin peptide comprising a peptide having the amino acid sequence set forth in SEQ ID NO:119.

110. (previously presented) The composition of claim 100, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:119.

111. (withdrawn) The composition of claim 100, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:55.

112. (withdrawn) The composition of claim 100, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:60.

113. (withdrawn) The composition of claim 100, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a polypeptide having the amino acid sequence set forth in SEQ ID NO:62.

114. (previously presented) The composition of claim 81, wherein said antigen or said antigenic determinant is a ghrelin peptide, and wherein said amino acid linker with said second attachment site is bound to the C-terminus of said ghrelin peptide.

115. (previously presented) The composition of claim 114, wherein said ghrelin peptide contains an n-octanoyl modification of a serine residue being or corresponding to the serine residue at position 3 of SEQ ID NO:31.

116. (previously presented) The composition of claim 115, wherein said ghrelin peptide comprises a peptide having the amino acid sequence set forth in SEQ ID NO:119.

117. (canceled)

118. (previously presented) The composition of claim 116, wherein said RNA-bacteriophage is RNA-bacteriophage Q $\beta$ .

119. (previously presented) The composition of claim 118, wherein said virus-like particle of RNA-bacteriophage Q $\beta$  comprises one or more recombinant proteins having the amino acid sequence set forth in SEQ ID NO:4.

120. (previously presented) The composition of claim 119, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:119.

121. (withdrawn) The composition of claim 119, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:55.

122. (withdrawn) The composition of claim 119, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:60.

123. (withdrawn) The composition of claim 119, wherein said antigen or antigenic determinant is a ghrelin peptide consisting of a peptide having the amino acid sequence set forth in SEQ ID NO:62.



124. (canceled)

125. (canceled)

126. (currently amended) The composition of [claim 63] ~~claim 82~~, wherein said ghrelin consists of a polypeptide having the amino acid sequence set forth in SEQ ID NO:34[65], and wherein said sequence contains an n-octanoyl modification of the serine residue at position 3 of said sequence.

127. (canceled)

128. (previously presented) The composition of claim 126, wherein said RNA-bacteriophage is RNA-bacteriophage Q $\beta$ .

129. (previously presented) The composition of claim 128, wherein said virus-like particle of RNA-bacteriophage Q $\beta$  comprises one or more recombinant proteins having the amino acid sequence set forth in SEQ ID NO:4.

130. (previously presented) A pharmaceutical composition comprising:

- (a) the composition of claim 63; and
- (b) a pharmaceutically acceptable carrier.

131. (previously presented) The pharmaceutical composition of claim 130 further comprising an adjuvant.

132. (previously presented) The pharmaceutical composition of claim 130, wherein said pharmaceutical composition is devoid of an adjuvant.

133. (withdrawn) A process for producing a composition of claim 63 comprising:

(a) providing a core particle with at least one first attachment site, wherein said core particle comprises a virus-like particle of an RNA-bacteriophage;

(b) providing at least one antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is a ghrelin or ghrelin peptide, wherein said second attachment site is selected from the group consisting of:

(i) an attachment site not naturally occurring with said antigen or antigenic determinant; and

(ii) an attachment site naturally occurring with said antigen or antigenic determinant; and

and wherein said first attachment site is a lysine residue of said virus-like particle and said second attachment is a cysteine residue; wherein said second

attachment site is capable of association to said first attachment site through at least one non-peptide covalent bond; and

(c) combining said core particle and said at least one antigen or antigenic determinant, wherein said antigen or antigenic determinant and said core particle interact through said association to form an ordered and repetitive antigen array, and wherein said composition induces an immune response against ghrelin when administered to a mammal.

134. (previously presented) The composition of claim 63, further comprising a heterobifunctional cross-linker, wherein said heterobifunctional cross-linker contains a first functional group capable of reacting with said first attachment site and a second functional group capable of reacting with said second attachment site.

135. (previously presented) The composition of claim 119, further comprising a heterobifunctional cross-linker, wherein said heterobifunctional cross-linker contains a first functional group capable of reacting with said first attachment site and a second functional group capable of reacting with said second attachment site.

136. (previously presented) The composition of claim 129, further comprising a heterobifunctional cross-linker, wherein said heterobifunctional cross-linker contains a first functional group capable of reacting with said first

attachment site and a second functional group capable of reacting with said second attachment site.

137. (previously presented) The composition of claim 134, wherein said heterobifunctional cross-linker is succinimidyl-6-[ $\beta$ -maleimidopropionamido]-hexanoate (SMPH).

138. (previously presented) The composition of claim 135, wherein said heterobifunctional cross-linker is succinimidyl-6-[ $\beta$ -maleimidopropionamido]-hexanoate (SMPH).

139. (previously presented) The composition of claim 136, wherein said heterobifunctional cross-linker is succinimidyl-6-[ $\beta$ -maleimidopropionamido]-hexanoate (SMPH).